

What is claimed is:

1. A system for analyzing a plurality of samples in parallel, the system comprising:
a plurality of fluid phase separation process regions;
5 a plurality of ionization sources; and
a mass spectrometer having a plurality of sample inlets;
wherein each separation process region is in fluid communication with the mass spectrometer through a different ionization source of the plurality of ionization sources and through a different inlet of the plurality of inlets.
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2. The system of claim 1 wherein:
the mass spectrometer includes a plurality of mass analyzers; and
each ionization source of the plurality of ionization sources supplies ions to a different mass analyzer of the plurality of mass analyzers through a different inlet of the plurality of inlets.
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3. The system of claim 1 wherein:
the mass spectrometer includes a plurality of transducers; and
each transducer of the plurality of transducers is associated with a different ionization source of the plurality of ionization sources and is associated with a different inlet of the plurality
20 of inlets.
4. The system of claim 1 wherein:
the mass spectrometer includes a plurality of mass analyzers and a plurality of transducers;
25 each ionization source of the plurality of ionization sources supplies ions to a different mass analyzer of the plurality of mass analyzers through a different inlet of the plurality of inlets; and
each transducer of the plurality of transducers is associated with a different ionization source of the plurality of ionization sources and is associated with a different inlet of the plurality
30 of inlets.
5. The system of claim 4, further comprising a plurality of focusing elements disposed between the plurality of ionization sources and the plurality of mass analyzers.

6. The system of claim 5 wherein:

the mass spectrometer comprises a chassis and plurality of discrete modules retained by the chassis; and

5 each module of the plurality of modules comprises a mass analyzer of the plurality of mass analyzers and at least one of a transducer of the plurality of transducers and a focusing element of the plurality of focusing elements.

7. The system of claim 6 wherein each module of the plurality of modules further includes a
10 selectively dischargeable ion trap disposed between a different inlet of the plurality of inlets and a different mass analyzer of the plurality of mass analyzers.

8. The system of claim 1 wherein each module of the plurality of modules includes a housing defining at least one vacuum passage.
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9. The system of claim 6 wherein each module of the plurality of modules is removably affixed to the chassis.

10. The system of claim 6 wherein:
20 the chassis includes a plurality of electrical conductors; and
each module of the plurality of modules is in electrical communication with at least two conductors of the plurality of conductors.

11. The system of claim 10 wherein the chassis includes a plurality of electrical connectors,
25 and each module of the plurality of modules is adapted to mate with a connector of the plurality of connectors.

12. The system of claim 10 wherein the chassis comprises a circuit board.

30 13. The system of claim 10 wherein the chassis comprises an electrically insulating material.

14. The system of claim 6 wherein the plurality of modules are disposed in a two-dimensional array.

15. The system of claim 1 wherein each inlet of the plurality of inlets is disposed at least about one centimeter apart from every other inlet of the plurality of inlets.

5 16. The system of claim 6, further comprising at least one vacuum pump, wherein each module of the plurality of modules is in fluid communication with the at least one vacuum pump.

17. The system of claim 6, further comprising a vacuum enclosure and a vacuum pump adapted to evacuate the vacuum enclosure, wherein the plurality of modules are disposed
10 within the vacuum enclosure.

18. The system of claim 17 wherein each module of the plurality of modules comprises at least one internal partition.

15 19. The system of claim 17 further comprising at least one partition disposed within the vacuum enclosure between at least two modules of the plurality of modules.

20. The system of claim 1 wherein each separation process region of the plurality of separation process regions is microfluidic.
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21. The system of claim 20 wherein the plurality of separation process regions are disposed within a unitary microfluidic device.

22. The system of claim 1 wherein the plurality of separation process regions includes a
25 plurality of liquid chromatography columns.

23. The system of claim 2 wherein each mass analyzer of the plurality of mass analyzers comprises any of a time-of-flight mass analyzer, a quadrupole mass analyzer, and an ion trap mass analyzer.
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24. The system of claim 2, further comprising a plurality of flow-through detection regions disposed between the plurality of separation process regions and the plurality of mass analyzers.

25. The system of claim 2 wherein the number of separation process regions of the plurality of separation process regions equals the number of mass analyzers of the plurality of mass analyzers.

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26. The system of claim 6, further comprising a common controller, wherein each module of the plurality of modules are in electrical communication with the common controller.

27. The system of claim 6, further comprising a common voltage source, wherein each
10 module of the plurality of modules is in electrical communication with the common voltage source.

28. A modular mass spectrometer device for analyzing a plurality of samples in parallel, the device comprising:

15 a vacuum enclosure defining a plurality of sample inlets;
a chassis disposed at least partially within the vacuum enclosure;
at least one vacuum pump for evacuating the vacuum enclosure; and
a plurality of modules adapted to mate with the chassis within the vacuum enclosure, the
plurality of modules including a plurality of mass analyzers disposed downstream of the plurality
20 of sample inlets and including any of:
a plurality of focusing elements disposed between the plurality of sample inlets
and the plurality of mass analyzers; and
a plurality of transducers disposed downstream of the plurality of mass
analyzers.

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29. The device of claim 28 wherein each module of the plurality of modules comprises a mass analyzer of the plurality of mass analyzers, a focusing element of the plurality of focusing elements, and a transducer of the plurality of transducers.

30. The device of claim 28, further comprising a plurality of selectively dischargeable ion traps disposed between the plurality of sample inlets and the plurality of focusing elements.

31. The device of claim 28 wherein each module comprises a housing defining at least one vacuum passage.

5 32. The device of claim 28 wherein each module of the plurality of modules comprises at least one internal partition.

33. The device of claim 28 further comprising at least one partition disposed within the vacuum enclosure between at least two modules of the plurality of modules.

10 34. The device of claim 28 wherein:
the chassis includes a plurality of electrical conductors; and
each module of the plurality of modules is in electrical communication with at least two conductors of the plurality of conductors.

15 35. The device of claim 28 wherein the chassis includes a plurality of electrical connectors, and each module of the plurality of modules is adapted to mate with a connector of the plurality of connectors.

20 36. The device of claim 28 wherein the chassis comprises an electrically insulating material.

37. The device of claim 28 wherein the chassis comprises a circuit board.

25 38. The device of claim 28 wherein the plurality of inlets are disposed in a two-dimensional array.

39. The device of claim 28 wherein each inlet of the plurality of inlets is disposed at least about one centimeter apart from every other inlet of the plurality of inlets.

30 40. The device of claim 28 wherein the plurality of modules are disposed in a two-dimensional array.

41. The device of claim 28 wherein each mass analyzer of the plurality of mass analyzers comprises any of a time-of-flight mass analyzer, a quadrupole mass analyzer, and an ion trap mass analyzer.

5 42. The device of claim 28, further comprising a plurality of ionization elements.

43. A high throughput analytical system comprising:
a plurality of fluid phase separation process regions;
a plurality of ionization elements in fluid communication with the plurality of separation
10 process regions; and

the device of claim 28, wherein each inlet of the plurality of inlets receives ions from a different ionization element of the plurality of ionization elements.

44. The system of claim 43, further comprising a plurality of flow-through detection regions
15 disposed between the plurality of separation process regions and the plurality of inlets.

45. The system of claim 43 wherein the number of separation process regions of the plurality of separation process regions equals the number of modules of the plurality of modules.